REMARKS/ARGUMENTS

Applicant has carefully reviewed the Office Action dated March 4, 2004 and the cited art. Reconsideration of the Examiner's rejection of the claims in their original form is respectfully requested. A total of 27 claims remain in the case. Claims 1-26 and 49 remain as originally filed.

Applicant notes that the restriction requirement is still deemed to be proper and is therefore made final.

Claim Rejection Under 35 U.S.C. 103 (a)

Claims 1-26 and 49 are rejected under 35 U.S.C. 103(a) as being obvious and therefore unpatentable over Tusim et al, Corbett et al, or Pontiff.

The Examiner draws Applicant's attention to Column 1, lines 38-51 and Column 11, lines 22-37 of Tusim et al. which disclose foam particles having a bulk density in the claimed range and having good energy absorbing properties; to column 3, lines 15-26 and the working examples of Corbett et al. which disclose foam particles having a bulk density in the claimed range; and to Column 10, lines 51 to 63 of Pontiff, et al. which disclose foam beads having a bulk density within the claimed range. The Examiner's position is that since each one of these references uses the claimed amount of blowing agent in its process for making the foamed particles, that each reference would have the same lower loss (of blowing agent) as claimed.

The Invention

The invention pertains to foamed cellular particles that are formed from expandable polymer particles and

that have a bulk density ranging between about 34.3 pounds per cubic foot and 12.5 pounds per cubic foot. Since the foamed cellular particles contain a sufficient amount of blowing agent, i.e. less than 6.0 wt %, they are still "expandable". A great advantage is that the particles can be produced at the polymer's site and then shipped to the converter's site for further processing without the need for any additional blowing agent or other pre-treatment at the converter's site prior to the pre-expansion and/or molding processes. Thus, the foamed cellular particles of the claimed invention are an "intermediate product" between the initial expandable particles and the final foamed article.

The expandable polymer particles, which are the precursor particles for the foamed cellular particles, are produced through methods such as solution polymerization, suspension polymerization, bulk polymerization, and extrusion and are then formed into foamed cellular particles. (Claims 11-21) These expandable particles are "high-density" beads with a diameter of about 0.2 to 4.0 millimeters, and a bulk density ranging between about 32 to 40 pounds per cubic foot. They are comprised generally of a styrenic-based polymer (claims 6-10) and contain a blowing agent amount that is less than 10 weight %, and most preferably is between 9.0 and 3.0 weight %.

The resulting foamed cellular particles have a bulk density ranging between about 34.3 pounds per cubic foot and 12.5 pounds per cubic foot (claim 1), preferably 25 pounds per cubic foot, and a blowing agent in the amount less than 6.0 wt %. The foamed cellular particles have a fixed established cell structure, i.e. the number of

cells is fixed (Claim 5) and remains the same during shipment, storage, and/or the foam molding processes. Even though the number of cells is fixed, it is to be understood that the cell size does increase during the final pre-expansion and/or molding processes.

The foamed cellular particles have a blowing agent amount that is less than 6.0 weight percent (claim 1), preferably, between 2.0 and 5.0 weight percent (Claim 2), and more preferably between about 2.5 and 3.5 weight percent (Claim 3). The foamed cellular particles have an average particle size ranging between about 0.2 and 3 millimeters, preferably between about 0.3 and 2 millimeters.

The foamed cellular particles contain a sufficient amount of blowing agent so that they can be shipped to the converter's site where the final foamed articles are formed. This feature is emphasized in Claim 1 "...and for a predetermined time at room temperature having a blowing agent weight loss at least 15% to 50% lower compared to the expandable particles in the same predetermined time at room temperature". In view of this, it is not necessary for the foamed cellular particles to be further impregnation with any blowing agent at the converter's site for the pre-expansion and/or molding processes. (Page 15, line 28 to page 16, line 1.)

The foamed cellular particles have a blowing agent weight loss at least 15% to 50% lower than that of the expandable particles used to form the foamed cellular particles in the same time at room temperature. As explained in the specification, the reason for this is that since the foamed cellular particles are larger than the expandable particles, the mean path for diffusion of

the blowing agent through the particle is longer, thereby increasing the shelf life of the foamed cellular particles. (Page 33, lines 26-31.) Also, since the foamed cellular particles will generally have a lower amount of blowing agent compared to the precursor expandable particles, the foamed cellular particles will have a lower driving force for diffusion.

In summary, the density range, the amount of blowing agent, and the established cell structure of the foamed cellular particles of the claimed invention allow for a sufficient amount of blowing agent to remain in the cells for a sufficient period of time so that no additional blowing agent needs to be added to the foamed cellular particles at the converter's site prior to subjecting the foamed cellular particles to the pre-expanding and/or molding processes for producing the final foamed molded articles.

The Cited Art

Tusim, et al., U.S. Patent No. 6,213,540 B1 relates to an energy-absorbing article that is formed of extruded thermoplastic foam. Lines 37 through 51 in Column 1 of Tusim, et al. refer to the prior art and read as follow: "A conventional automobile EAU core of foamed olefinic polymer prepared by feeding expandable beads of a polypropylene-type resin in a mold capable of enclosing the particles but allowing escape of gases there from, and heating the expandable beads at a temperature at which the beads expand and soften and melt-adhere to each other into a mass, whereby a foamed molded article expanded to the same shape and size as the cavity of the mold is formed. An automobile EAU core prepared from beads of a polypropylene-type resin foam requires a foam

density of about 12.5 pounds per cubic foot to achieve a compressive strength of about 250 pounds per square inch at 25% strain. Automobile EAU cores having comparable compressive strength at a lower density would be desirable."

This automobile core with a foam density of about 12.5 pounds is a final foamed article; whereas, the foamed cellular particles of the claimed invention that are used to form a final foamed article, have a density range of 34.3 to 12.5 pounds per cubic foot and are an "intermediate product" between the precursor expandable particles and the final foamed article. The foamed cellular particles of the invention are still expandable and can, in fact, be further expanded at the converter's site to a lower density of commercial value into final foamed articles.

Lines 21-37 in column 11 of Tusim et al., disclose a foam extrudate that has "... a density of less than 20 pounds per cubic foot, preferably from about 2 to 12 pounds per cubic foot, more preferably 2.5 to 10 pounds per cubic foot; and most preferably from about 3 to 8 pounds per cubic foot". Column 11, lines 38 to 55 of Tusim et al. teach that the "...extruded thermoplastic foam products can be foamed or formed into the desired shape of the energy absorbing article, such as an automobile EAU, in which it is used, or the extruded thermoplastic foam may be cut and shaped into the desired shape of the energy absorbing article. Alternatively, the energy absorbing article may be comprised of a plurality of components which are joined, such as by hot air welding, steam welding, radio frequency welding, adhesives, mechanical fasteners, or the like, to form a

composite energy absorbing article. In this manner, energy absorbing articles having unusual shapes, or containing portions of various densities may be prepared. Also, composite articles containing materials other than the extruded thermoplastic foam may be prepared. Another alternative method of utilizing the extruded thermoplastic foams of this invention in composite energy absorbing articles is to use the extruded thermoplastic foams as inserts in a closed mold in which a suitable matrix resin is dispersed."

From the above, it is clear that Tusim et al. pertains generally to a foamed extrudate that in this form is used as an energy-absorbing article or is used to form various energy-absorbing articles through several forming methods, none of which methods include subjecting the foamed extrudate to pre-expanding and/or molding processes to form a final foamed molded article.

Column 4, lines 46-55 of Tusin, et al. state "... the amount of foaming agent added to the thermoplastic resin or blend is preferably in the range of 0.01-0.14 gram mole by weight per 100 grams by weight of the thermoplastic resin or blend. Typically, the amount of foaming agent incorporated into the thermoplastic resin or blend depends on the desired foam density...a greater amount of foaming agent results in a higher expansion ratio...and thus a lower foam density."

Applicant is not certain whether the amount of the foaming agent in Tusim et al. is equivalent to that of the claimed invention. In any event, Tusim et al. does not disclose foamed cellular particles made from expandable particles and which foamed cellular particles have a density range between about 12.5 to about 34.3

pounds per cubic foot and a blowing agent amount less than 6.0 % by weight.

In the claimed invention, foamed cellular particles are formed from expandable particles. These foamed cellular particles have a density range, a fixed number of cells, and a blowing agent amount as recited in the claims. These components of the foamed cellular particles of the invention synergistically work together to provide a path in the particles so that the blowing agent slowly diffuses such that for a predetermined time at room temperature the blowing agent weight loss out of the particles is at least 15% to 50% lower compared to that of the expandable particles from which the foamed cellular particles are formed under the same environmental conditions.

As discussed hereinabove, these features of the claimed invention, particularly that of claim 1, are important in carrying out an object of the invention where the expandable particles are expanded at the polymer's site to form the foamed cellular particles and these foamed cellular particles can be shipped to the converter's site for further processing i.e. expansion and/or molding, to form final foamed articles.

The foamed extrudates of Tusim et al. are generally the final product. It is not certain as to the amount of blowing agent existing in these foamed extrudates. Since these foamed extrudates are the final product, there is really no need for them to contain any blowing agent. These extrudates have a density range of less than 20 pounds per cubic foot, and most preferably from about 3 to 8 pounds per cubic foot. The upper values of this density range may overlap with the density values for the

foamed cellular particles of the invention. However, all the claimed features, particularly that of claim 1, synergistically work together to fulfill the objects of the invention.

Applicant submits that the Examiner has applied hindsight in his rejection of the claims based on Tusim et al., and that one skilled in the art would not look to Tusim et al. for the claimed invention.

Corbett et al., U.S. Patent No. 3,607,999 relates to the recovery of thermoplastic foam scrap as extrudable granules by grinding the scrap, passing it over a vibrating cooled trough, applying radiant heat to the scrap, and cooling and grinding the scrap to provide an extrudable pellet or particle.

Lines 13-26 in column 3 of Corbett et al disclose that the "... polystyrene foam on the tray appears to collapse and form generally cohering masses which have the appearance of a lacy web which is passed to a pair of cooled compression rolls having a temperature of about 38°C. The polystyrene discharge from the compression rolls is in the form of a sheet and is subjected to a blast of room temperature air, passed to the grinder and discharged as a pelleted densified polystyrene which has a bulk density of 30.7 pounds per cubic foot and a solution viscosity of 8.91 centipoise...Prime extrusion grade polystyrene in the form of generally cylindrical pellets generally has a bulk density of about 36 pounds per cubic foot."

In Corbett et al., the bulk density of the pellets may be either 30.7 pounds per cubic foot or 36 pounds per cubic foot, whereas the density of the foamed cellular particles of the claimed invention ranges between 12.5

and 34.3 pounds per cubic foot. Granted that these density values overlap along both ranges; however, "density" is not the only important factor in the claimed invention. The claimed invention, particularly that of claim 1, allows the foamed cellular particles to be produced at the polymer producer's site and then shipped to the converter's site for further processing, i.e. expansion and/or molding for the production of final foamed articles.

The foamed cellular particles of the claimed invention include a fixed cell structure, i.e. a fixed number of cells. This feature is important for the integrity of the particles. In Corbett et al. it is questionable whether there is any cell structure in the scrap in view of the destructive forces that the scrap is subjected to for its recovery. In column 3, lines 13 - 15, "...the polystyrene foam on the tray appears to collapse and form generally cohering masses which have the appearance of a lacy web which is passed to a pair of cooled compression rolls." In column 2, lines 8-10, sufficient heat is applied to cause the synthetic resinous particles to at least partially collapse and coalesce to form a sintered foam. These teachings seem to indicate that if any cell structure even existed in the particles that it would be destroyed. In the foamed cellular particles, a cell structure is created and is maintained in the foamed cellular particles so that they can be converted into a final foamed article.

In the invention, the integrity of the cells must be maintained in order to carry out an object of the invention, which is to assure that the foamed cellular particles have a sufficient amount of blowing agent so

that they can be further processed, which may be at the converter's site, into foamed articles without the need to further impregnate a blowing agent into the particles.

Corbett et al. does not teach the use of any blowing agent in the scrap particles. The examples of Corbett et al. show that polystyrene foam having the lower bulk densities are densified and then processed to form a product with high bulk densities ranging between 14 to 37 pounds per cubic foot. The only similarity between the claimed invention and the foamed scrap of Corbett et al. is that some density values for the product in the Examples of Corbett et al. may be the same to those of the claimed invention.

As stated hereinabove, in the claimed invention it is important that cells be created in the expandable particles and maintained in the foamed cellular particles; it is important that the foamed cellular particles have the claimed density range so that a longer diffusion path for the blowing agent is formed; and that the foamed cellular particles have the claimed amount of blowing agent so that the foamed cellular particles can effectively be processed to form a final foamed article. Corbett et al. teaches the recycling of foamed final articles, whereas the invention teaches the preparation of expandable foamed cellular particles that are the basis for molding new foamed final articles.

In summary, Corbett et al. relates to the recovery of scrap particles that are heated to cause them to collapse and coalescence so that pellets can be formed. The pellets may not necessarily be expandable nor are they foamed cellular particles. The scrap particles with the lower densities are processed to form products that have

a density that lie in the density range of the claimed invention; however, the scrap particles of Corbett et al. do not contain a blowing agent or have a cell structure as does the foamed cellular particles of the claimed invention.

Applicant submits that the Examiner has applied hindsight in his rejection of the claims based on Corbett et al., and that one skilled in the art would not look to Corbett et al. for the claimed invention.

Pontiff et al., U.S. Patent No. 5,026,736 relates to moldable shrunken thermoplastic polymer foam beads, and specifically refers to polyolefin beads, which are used in the industry to overcome some of the drawbacks of polystyrene foam, where polyolefin foam is more resilient and flexible than polystyrene foam, and therefore is of greater use for the packaging of fragile items. (Col. 1, lines 40-51)

There is a fundamental difference between the foam beads of Pontiff et al. and the foamed cellular particles of the invention. The beads of Pontiff, et al. are allowed to shrink to a predetermined density after the melt polymer is extruded and cut to form foam beads. As taught in Column 5, lines 39-47, the blowing agent and/or air from the foam is purposely removed from the beads so that the beads are exposed to ambient pressure thereby causing them to shrink.

Column 8, lines 9-20 teach that the "shrunken" foam beads are defined as being reduced from their maximum expansion to produce surface wrinkles, dimples or the like. The shrinkage occurs because of the blowing agent's rapid diffusion from the foam structure relative to its replacement with air and/or the low room

temperature vapor pressure of the blowing agents causing a decrease in volume of the cells as cooling progresses. This is completely opposite to what happens to the foamed cellular particles of the claimed invention in that the blowing agent slowly diffuses out of the foamed cellular particles. Also, the foamed cellular particles of the claimed invention have an increase in volume of the cells and a decreased density relative to the expandable particles used to form the foamed cellular particles of the invention.

The shrunken, cross-linked polyolefin foam beads of Pontiff et al. have densities ranging from about 0.8 to about 20 pounds per cubic foot, and foam beads used to produce higher density moldings have densities in the range of from about 12 to about 20 pounds per cubic foot. (Column 10, lines 51-63) The foamed cellular particles of the claimed invention are not "shrunken" nor can they be "shrunken" in that if shrunken they would no longer be able to function in the manner in which they are intended which is already discussed extensively herein above.

The beads of Pontiff et al. are expanded via a blowing agent; however, Pontiff et al appears to be silent with regard to the amount of blowing agent remaining in the shrunken beads. Based on the teachings of Pontiff, et al., it would seem natural to assume that no blowing agent remains in the beads since the whole purpose of Pontiff et al. is to produce "shrunken" beads.

In summary, the only similarity between the foam beads of Pontiff, et al. and the foamed cellular beads of the claimed invention is the fact that their density values overlap. This in itself does not make the claims of the claimed invention obvious. The claimed invention

provides foamed cellular particles that have a fixed cell structure and a blowing agent in an amount less than 6.0wt % which features enable a slow diffusion of the blowing agent out of the particles so that the foamed cellular particles can be shipped to the converter's site for the production of final foamed articles at the converter's site.

Applicant submits that the Examiner has applied hindsight in his rejection of the claims based on Pontiff et al., and that one skilled in the art would not look to Pontiff et al. for the claimed invention.

Summary and Conclusion

The claimed invention, particularly that of claim 1, is not taught, disclosed, or even suggested in the cited references when considered singly or in combination. Independent claim 1 is not obvious and therefore is patentable over the cited references. Dependent claims 2-26 and 49 are patentable on their own merits in addition to being directly or indirectly dependent on a patentable claim 1.

Applicant for the first time discloses and claims foamed cellular particles formed from expandable particles and having a bulk density range of 34.3 to 12.5 pounds per cubic foot and a blowing agent in an amount less than 6.0 wt % based on the weight of the polymer, which for a predetermined time at room has a blowing agent weight loss at least 15% to 50% lower compared to the expandable particles in the same predetermined time at room temperature.

The only similarity between the claimed invention and any of the cited references is that some of the density values for the cited references may fall within the

claimed density range for the foamed cellular particles of the claimed invention. However, as discussed herein above, the claimed invention involves more than a density range.

Applicant respectfully submits that the claims are to be considered in their entirety and not in piece meal fashion, and that a "density value" alone will not reproduce the claimed invention of claims 1-26 and 49.

This is a "no-fee" amendment.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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